

We claim:

1. An abrasive cutting tool comprising:

a) a substrate surface having a plurality of teeth extending therefrom, each tooth having a surface, and

b) a layer comprising abrasive grains, the layer being chemically bonded to at least a portion of the surface of each tooth to define a plurality of cutting levels parallel to the substrate surface,

wherein the grains have a relative strength index of at least one minute, as measured by the FEPA standard for measuring the relative strength of saw diamonds.

2. The tool of claim 1 wherein the substrate surface has an intended direction of movement, wherein the plurality of teeth includes successive teeth having successively lower uppermost cutting levels in the direction of the intended direction of movement, thereby producing a cutting surface having a negative angle of inclination with respect to the intended direction of movement.

3. The tool of claim 1 wherein the substrate surface has an intended direction of movement, wherein at least a portion of each tooth has a face which is inclined at a negative angle with respect to the intended direction of movement, and at least a portion of the grains are bonded to the face having the negative angle of inclination.

4. The tool of claim 3 wherein the grains bonded to the face having the negative angle of inclination are present in a concentration wherein the angle of inclination in degrees is no more than  $1/3$  of the grain concentration in percent.

5. The tool of claim 1 comprising successive cutting levels comprising at least 50% of the plurality of cutting levels, wherein each cutting level of the successive cutting levels contains about the same number of grains.

6. The tool of claim 1 wherein a portion of each tooth is associated with successive cutting levels comprising at least 50% of the cutting levels of the tooth, and wherein each cutting level of the successive cutting levels contains about the same number of grains.

7. The tool of claim 6 wherein the portion of each tooth associated with the successive cutting levels having about the same number of grains has a constant cross section.

8. The tool of claim 6 wherein the portion of each tooth associated with the successive cutting levels having about the same number of grains has an uppermost cross section and a lowermost cross section, and the uppermost cross section is smaller than the lowermost cross section.

9. The tool of claim 6 wherein the successive cutting levels having about the same number of grains comprise at least the lowermost 50% of the cutting levels of each tooth.

10. The tool of claim 9 wherein the substrate surface has an intended direction of movement, wherein at least the uppermost 10% of each tooth has a face which is inclined at a negative angle with respect to the intended direction of movement, and at least a portion of the grains are bonded to the face having the negative angle of inclination, thereby producing a trapezoidal cutting surface.

11. The tool of claim 1 wherein the concentration of the grain is less than 75%.

12. The tool of claim 1 wherein the teeth have a hardness of between about 38 and 42 Ra.

13. A method of cutting, comprising the steps of:

a) providing an abrasive cutting tool comprising:

i) a substrate surface having a plurality of teeth extending therefrom, each tooth having a surface, and

ii) a layer comprising abrasive grains, the layer being chemically bonded to at least a portion of the surface of each tooth to define a plurality of cutting levels parallel to the substrate surface, the cutting levels comprising a first uppermost cutting level and a second uppermost cutting level, the grains having a predetermined wear resistance,

b) moving the substrate surface in an intended direction of rotation,

c) contacting the uppermost cutting level of at least one tooth to a workpiece at a point of contact,

d) applying a constant force to the tool directed at the point of contact,

wherein the constant force is sufficient to cut the workpiece, the strength of the bond is sufficient to resist peeling, the predetermined wear resistance of the grains is such that the grains of the first uppermost cutting level fracture under application of the constant force, and the wear resistance of the teeth are such that the portion of the tooth associated with the first uppermost cutting level wears at about the same rate as the grains of the first uppermost cutting level fracture, thereby causing essentially simultaneous removal of the grains of the first uppermost cutting level from their bond and the portion of the tooth associated with the first uppermost cutting level, and thereby exposing the grains of the second uppermost cutting level to the workpiece.

14. The method of claim 13 wherein the plurality of teeth includes successive teeth having successively lower uppermost cutting levels in the intended direction of movement, thereby producing a cutting surface having a negative angle of inclination with respect to the intended direction of movement.

15. The method of claim 13 wherein at least a portion of each tooth has a face which is inclined at a negative angle with respect to the intended direction of movement, and at least a

portion of the grains are bonded to the face having the negative angle of inclination.

16. The method of claim 15 wherein workpiece produces abrasive swarf when cut, and wherein the grains bonded to the face having the negative angle of inclination are present in a concentration wherein the angle of inclination in degrees is no more than  $1/3$  of the grain concentration in percent, thereby protecting the grains of the uppermost cutting level from undercutting.

17. The method of claim 13 comprising successive cutting levels comprising at least 50% of the plurality of cutting levels, wherein each cutting level of the successive cutting levels contains about the same number of grains.

18. The method of claim 17 wherein a portion of each tooth is associated with successive cutting levels comprising at least 50% of the cutting levels of the tooth, and wherein each cutting level of the successive cutting levels contains about the same number of grains.

19. The method of claim 18 wherein the portion of each tooth associated with the successive cutting levels having about the same number of grains has a constant cross section.

20. The method of claim 18 wherein the portion of each tooth associated with the successive cutting levels having about the same number of grains has an uppermost cross section and a lowermost cross section, and the uppermost cross section is smaller than the lowermost cross section.

21. The method of claim 13 wherein the grain toughness is characterized by a relative strength index of at least one minute, as measured by the FEPA standard for measuring the relative strength of saw diamonds.

22. The method of claim 13 wherein the grain size is between about 100 um and 600 um.

23. The method of claim 18 wherein the successive cutting levels having about the same number of grains comprise at least the lowermost 50% of the cutting levels of each tooth.

24. The method of claim 13 wherein the concentration of the grain is less than 75%.

25. The method of claim 13 wherein the workpiece is masonry having a Knoop hardness of at least 700 Rc.

26. The method of claim 13 wherein the teeth have a hardness of between 38 Ra and 42 Ra.

27. An abrasive cutting tool comprising:

a) a substrate surface having a plurality of teeth extending therefrom, each tooth having a surface and

b) a layer comprising abrasive grains, the layer being chemically bonded to at least a portion of the surface of each tooth to define a plurality of cutting levels parallel to the substrate surface,

wherein the substrate surface has an intended direction of movement, wherein the plurality of teeth includes successive teeth having successively lower uppermost cutting levels in the direction of the intended direction of movement, thereby producing a cutting surface having a negative angle of  $112^\circ$  inclination with respect to the intended direction of movement.

28. An abrasive cutting tool comprising:

- a) a substrate surface having a plurality of teeth extending therefrom, each tooth having a surface, and
  - b) a layer comprising abrasive grains, the layer being chemically bonded to at least a portion of the surface of each tooth to define a plurality of cutting levels parallel to the substrate surface,
- wherein the substrate surface has an intended direction of movement, wherein at least a portion of each tooth has a face which is inclined at a negative angle with respect to the intended direction of movement, and at least a portion of the grains are bonded to the face having the negative angle of inclination.

29. The tool of claim 28 wherein at least the uppermost 10% of each tooth comprises the face which is inclined at a negative angle with respect to the intended direction of movement.

30. An abrasive cutting tool comprising:

- a) a substrate surface having a plurality of teeth extending therefrom, the teeth having a surface and a predetermined wear resistance, and
- b) a layer comprising abrasive grains, the layer being chemically bonded to at least a portion of the surface of each

tooth to define a plurality of cutting levels parallel to the substrate surface, the grains having a predetermined wear resistance,

wherein the wear resistance of the teeth and the wear resistance of the grains are predetermined such that, when a given cutting level contacts a workpiece under an optimum load, the grains of the given cutting level wear and fracture at about the same rate as the portion of the tooth associated with the given cutting level wears away.

31. The tool of claim 30 wherein the teeth have a hardness of between 38 Ra and 42 Ra.

32. The tool of claim 31 wherein the grains have a relative strength index of at least one minute, as measured by the FEPA standard for determining the relative strength of saw diamonds.

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